E & A

CONTROL OF AMERICAN FOULBROOD

DEP. BUREAU ENTOM
-7 JUL. 1920

E. F. PHILLIPS
Apiculturist

FARMERS' BULLETIN 1084
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. March, 1920

WASHINGTON: GOVERNMENT PRINTING OFFICE: 1920

AMERICAN FOULBROOD is a disease of the brood of bees which is causing great losses to American beekeepers. It has existed almost since bees were first brought to North America.

It is important that the beekeeper should know whether American foulbrood or European foulbrood is in his apiary, for the two do not respond to the same treatment.

In American foulbrood control it is necessary that all combs, honey, and other materials from the inside of the hive be taken from the bees and that a chance be given them to establish themselves again on new combs. Several methods are given in this bulletin, but the underlying principle is the same in all cases.

No measures which the beekeeper may take will put his bees in such condition that they will not contract this disease, but by guarding them from infection he may save himself much worry and financial loss.

The facts about the disease on which the treatment is based are discussed in this bulletin and the treatment is described in full.

CONTROL OF AMERICAN FOULBROOD

CONTENTS.

	Page.		Page.
Importance of early detection	3	Basis of treatment	7
Name of the disease	3	Preventive measures	9
Symptoms	4	Remedial measures	10

IMPORTANCE OF EARLY DETECTION.

GREAT LOSS and considerable anxiety among beekeepers in many parts of the country have been caused by the disease known as American foulbrood. The symptoms have long been known and the treatment now in general use was discovered hundreds of years ago, yet there are beekeepers who fail to distinguish this disease from the other brood diseases, especially European foulbrood. The disease has existed in America almost as long as bees have been kept here, but the progress in commercial beekeeping of the last half century has resulted in greatly extending its distribution.

Colonies in an apiary often become infected before the owner realizes that disease is present. He may erroneously attribute the losses observed to some other cause. In this way the disease, before it is discovered, gets a start which makes eradication difficult. In view of the widespread distribution of American foulbrood, it is most desirable that all beekeepers learn how to recognize it when it appears, how to distinguish it from European foulbrood, and how to keep the diseases under control.

NAME OF THE DISEASE.

When American beekeepers first observed this disease they gave it the name "foul brood," by which it had long been known in Europe. With the discovery of another brood disease in New York in 1894, or rather with the recognition of the difference between the two diseases, considerable confusion arose regarding the names of the various troubles. This was increased by the work then done on the causes of the two diseases, the trouble lying in the erroneous results of still earlier work on the organisms found in the diseased material. After consultation with beekeepers and apiary inspectors, it was decided to adopt the name American foulbrood for the disease which had been known in this country for so long.

The name was first used in a circular[1] of the Bureau of Entomology and has been generally accepted by beekeepers throughout this country and in other countries. The adjective "American" was chosen because it appeared that this disease was first subjected to a thorough investigation from the bacteriological standpoint by an American investigator, while the other serious disease of the brood of bees had been investigated previously in Europe. The names obviously are not intended to convey the idea that the diseases originated one in America and the other in Europe, for the honeybee is not native to America. The names were chosen simply that beekeepers might have names which could be used with safety, and which would not lead to confusion by being descriptive.

SYMPTOMS.

The beekeeper who discovers a brood disease among his bees should know whether he has to deal with American foulbrood or European foulbrood, for they do not respond to the same treatment. The symptoms of American foulbrood are the outward manifestations of the disease, being simply the appearance of the larvæ or pupæ after death. The symptoms of European foulbrood vary greatly (see Farmers' Bulletin 975), while in American foulbrood they are much more definite. Diagnosis by bacteriological methods is less necessary for American foulbrood than for European foulbrood, but any doubtful samples should be sent to the Bureau of Entomology for diagnosis.[3]

In regions where both diseases occur, beekeepers at times experience difficulty in distinguishing them, owing chiefly to insufficient observation of the symptoms. If European foulbrood appears in an apiary in the spring, and if American foulbrood is observed later, the beekeeper may erroneously conclude that both types are manifestations of one disease, or that European foulbrood changes to American foulbrood. Such is not the case. It is therefore essential that the symptoms be studied with great care, since to treat American foulbrood by methods applicable only to European foulbrood will result in the spread rather than the eradication of the disease.

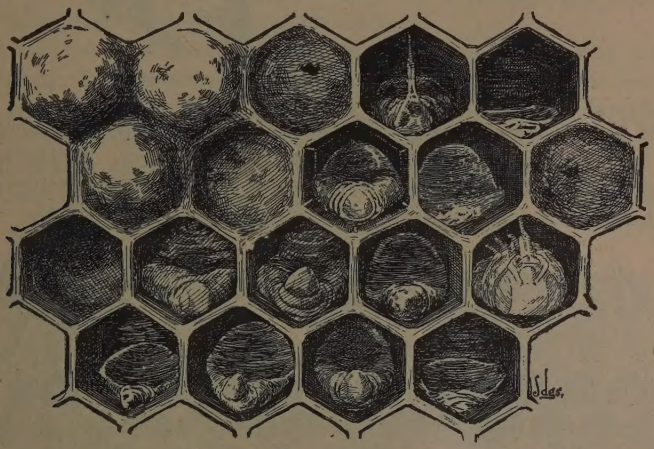
---

[1] Phillips, E. F. The brood diseases of bees. United States Department of Agriculture, Bureau of Entomology, Circular 79. 5 p., 1906.

[3] If dead brood is observed and the beekeeper is not able to diagnose it with accuracy, samples may be sent the Bureau of Entomology for examination. A piece of comb containing dead larvæ, about 4 by 5 inches, should be cut out and mailed in a heavy pasteboard or wooden box. Tin boxes should never be used, as the brood usually molds in transit, making examination impossible. The sample should not be wrapped before being placed in the box. A suitable box for sending samples will be mailed on request.

It is not possible to diagnose from empty combs, and no honey should be included in the sample, as it is valueless in diagnosis and will probably spoil the sample as well as other mail matter. The name of the sender must always appear on the package, and any available data should be sent in a letter. Never inclose a letter in the box with the sample.

American foulbrood is frequently called simply "foul brood." Usually it shows itself in the larva just about the time that the larva fills the cell and after it has ceased feeding and has begun pupation. At this time it is sealed over in the comb (fig. 1, *a*, *b*, *f*). The first indication of the infection is a slight brownish discoloration and the loss of the well-rounded appearance of the normal larva (fig. 1, *l*). At this stage the disease usually is not recognized by the beekeeper. The larva gradually sinks down in the cell and becomes darker in color (fig. 1, *h*, *m*), and the posterior end lies against the bottom of the cell. Frequently the segmentation of the larva is clearly marked. By the time it has partially dried down and has become



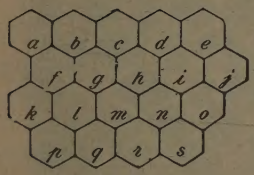


FIG. 1.—American foulbrood: *a*, *b*, *f*, Normal sealed cells; *c*, *j*, sunken cappings, showing perforations; *g*, sunken capping not perforated; *h*, *l*, *m*, *n*, *q*, *r*, larvæ affected by disease; *e*, *i*, *p*, *s*, scales formed from dried-down larvæ; *d*, *o*, pupæ affected by disease. Three times natural size.

quite dark brown (coffee colored) the most typical characteristic of this disease manifests itself. If a match stick or toothpick is inserted into the decaying mass and withdrawn, the larval remains adhere to it and are drawn out in a thread (fig. 2), which sometimes extends for several inches before breaking. This ropiness is the chief characteristic used by the beekeeper in diagnosing this disease. The larva continues to dry down and gradually loses its ropiness until it finally becomes merely a scale on the lower side wall and base of the cell (fig. 1, *e*, *p*, *s*). The scale formed by the dried-down larva adheres tightly to the cell and can be removed with difficulty from the cell wall. The scales can be best observed when the comb is held with the top inclined toward the observer so that a bright light

strikes the lower side wall (fig. 3). A very characteristic and usually penetrating odor is often noticeable in the decaying larvæ. This, perhaps, can best be likened to the odor of heated glue.

The majority of the larvæ which die of this disease are attacked after being sealed in the cells. The cappings are often entirely re-

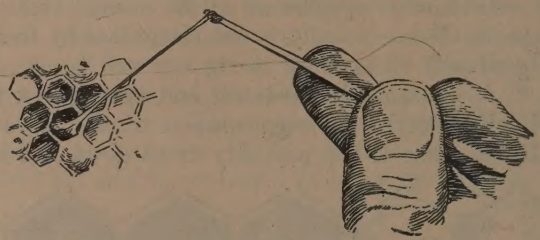


FIG. 2.—The ropiness of American foulbrood.

moved by the bees, but when they are left they usually become sunken (fig. 1, *g*, *c*, *j*) and frequently perforated (fig. 1, *c*. *j*). As the healthy brood emerges, the comb shows the scattered sunken cappings covering dead larvæ (fig. 3), giving it a characteristic appearance.

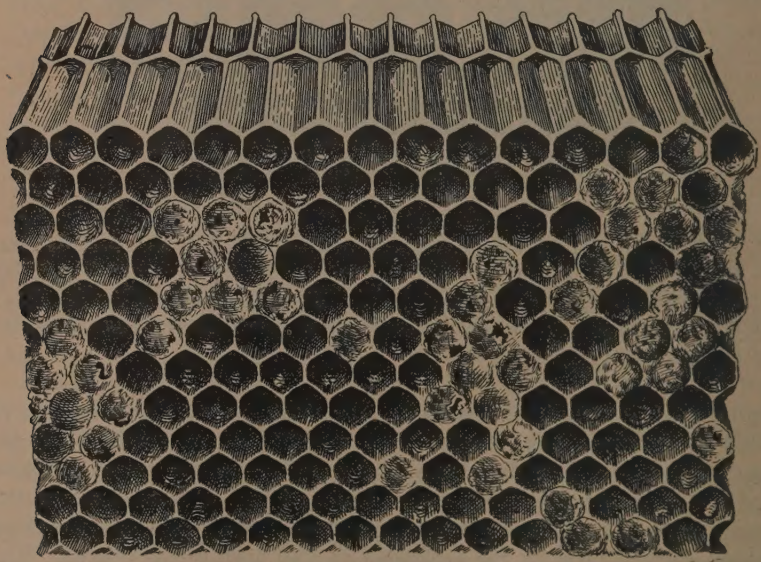


FIG. 3.—American foulbrood comb, showing irregular patches of sunken cappings and scales. The position of the comb indicates the best way to view the scales.

Pupæ also may die of this disease, in which case they, too, dry down (fig. 1, *o*, *d*), become ropy, and have the characteristic odor and color. The tongue frequently adheres to the upper side wall and often remains there even after the pupa has dried down to a scale.

Younger unsealed larvæ are sometimes affected. Usually the disease attacks only worker brood, but rare cases are found in which queen and drone brood are diseased.

BASIS OF TREATMENT.

The treatment of American foulbrood is based on certain definite observations concerning the nature of the disease and of the larvæ which die from it. The treatment was discovered long before the cause of the disease was suspected, but later work on the organism responsible for the disease has helped to explain the reasons for the treatment. For comparisons between the two diseases, the beekeeper should consult Farmers' Bulletin 975.

1. American foulbrood attacks colonies of all strengths and at any season of the year when the bees are active. In these respects it differs materially from European foulbrood. More samples of American foulbrood are received by the Bureau of Entomology during the season of the year when the beekeepers are working with their bees; that is, at times when they could best find it, than at other seasons. Samples, however, have been received during all months of the year, even in winter.

2. The disease does not disappear of its own accord. There may be cases in which a few cells in a colony are attacked by the disease and are cleaned out, but this is certainly a rare occurrence, and in general it may be stated that when the disease once enters the hive it will remain until the colony is destroyed, or until the disease is eradicated by the treatment given by the beekeeper.

3. The honey flow seems to have little effect on the course of the disease. When there is honey coming to the hive freely the bees generally rear brood more freely than during the seasons of dearth, and under such circumstances there is more material available for the development of American foulbrood. The disease, therefore, appears to spread more rapidly in the colony during a honey flow. During a heavy honey flow, when the larval food is made of fresh nectar in place of the old infested honey, the disease may appear to be less prevalent in the colony and may become less evident. On the other hand, during periods of dearth there is more likelihood that the bees will rob out colonies that have died of the disease, and it therefore appears in new colonies more rapidly when there is no honey flow.

4. All races and strains of bees are attacked by the disease. Italian bees are more vigorous and are better workers than the common German bees which were first brought to America. The German or black bees have so many bad qualities and so few good ones that the better beekeepers of the country are united in preferring the

Italian bees. In spite of their greater tendency to go out after honey from colonies that have died out, they are so much better that no beekeeper can afford to abandon Italian bees on this account.

5. American foulbrood is an infectious disease, caused by an organism known as *Bacillus larvae*. It was shown clearly by the experience of beekeepers before the disease was investigated from the bacteriological standpoint that it was infectious, and these investigations have supported the observations made by the beekeeper. The bacteriological work has shown further that the disease is caused by an organism that has never been found in any other brood disease of bees, and it is, therefore, a specific organism and American foulbrood is entirely distinct from European foulbrood or any other disease of bees. This is an important point, for there has been considerable confusion in the past in that a few beekeepers have claimed that one disease changes to the other. It should be stated that this supposition is not supported by any careful observations in the apiary, but it was recognized generally before the bacteriological investigations were made that the diseases are distinct.

6. The organism causing American foulbrood has been shown by the experience of beekeepers to be difficult to kill. It has long been known that it is not killed by any degree of cold ever encountered in the apiary, and it has also been known that long boiling is needed to make honey from a diseased colony safe for feeding to bees. These facts have been further confirmed by bacteriological observations, it having been shown that *Bacillus larvae* is a spore-bearing organism.

7. When a bee larva dies of American foulbrood the decaying mass adheres closely to the cell wall during practically all except the very earliest stages of decay, and also when it has dried down to a scale on the lower side wall of the cell. The bees are unable to remove all the scales, even under the most favorable conditions for house cleaning, although they may sometimes gnaw down a few cells and thus remove the scales.

8. The disease is spread from colony to colony through honey which becomes infected through being stored while the disease is in the hive. This is usually obtained by bees which go to rob hives in which the colonies are either weak or have died from the disease or from some other cause. The disease is frequently introduced to the apiary by the bees getting honey which has been shipped from an apiary containing American foulbrood. It is well known that this disease is present about most of the chief honey markets of the country, presumably introduced through honey shipped in to these centers.

9. It has been found necessary to disinfect honey from diseased colonies by boiling before feeding it to other colonies. This shows,

as indicated in the previous paragraph, that the organism is in the honey.

10. The disease as a rule does not spread through the apiary as rapidly as does European foulbrood. It is a malignant disease in that when a colony once becomes diseased it is doomed in time unless the beekeeper treats it by the methods herein described.

These facts have been discovered in the apiary rather than in the laboratory. They are supported by repeated observations, and while the records of observations are not as accurately made as are those of the laboratory, the correctness of most of the facts is attested by the experience of thousands of beekeepers. In certain cases, above mentioned, the observations have been corroborated by bacteriological findings.[1] The methods of treatment have all been devised in the apiary.

PREVENTIVE MEASURES.

No system of management of the apiary has yet been found which will prevent the entrance of American foulbrood. In this respect the disease differs greatly from European foulbrood. By observing the following precautions, however, the beekeeper frequently can prevent the bees from getting the honey from colonies which have the disease.

1. If a colony becomes weak from any cause, or if disease is suspected, contract the entrance to prevent robbing, and if robbing is imminent close the entrance entirely.

2. *Never feed honey purchased on the open market.* In case of doubt as to the source of honey, feed sugar sirup.

3. If within the range of possibility, see that no honey that comes from diseased apiaries is sold in the neighborhood. This may sometimes be accomplished by cultivating the home market so that there will be no incentive for bringing in other honey.

4. In introducing purchased queens, transfer them to clean cages provided with candy known to be free from contamination, and destroy the old cage, candy, and accompanying workers. Of course, if it is certain that the queen comes from a healthy apiary this is not necessary. The postal regulations now require that queen cages sent by mail either be provisioned with candy that will not transmit American foulbrood or that they be accompanied by a certificate from the apiary inspector that no disease has been found in the apiary.

5. Colonies of bees should never be purchased unless it is certain that they are free from disease.

---

[1] Bacteriological studies of bee diseases have been useful to practical beekeepers in explaining the reasons for success or failure with various treatments attempted. These studies have been especially important, however, because through them methods of laboratory diagnosis of the different diseases have been worked out.

6. The purchase of old combs, second-hand supplies, or second-hand honey cans is dangerous, unless it is certain that they have come from healthy apiaries.

REMEDIAL MEASURES.

The treatment of American foulbrood consists primarily in the elimination or removal of the cause of the disease. It is definitely known that American foulbrood is caused by a bacillus named *Bacillus larvae.* In treating this disease, therefore, the aim of the manipulation is to remove or destroy all of the bacteria of this species. It should be remembered that the effort is not to save the larvæ that are already dead or dying, but to stop the further devastation of the disease by removing all material capable of transmitting the cause of the trouble.

In all of the operations great pains should be taken not to spread the disease through carelessness. After handling a diseased colony the hands of the operator should be washed with water to remove any honey that may be on them. It does not pay to treat colonies that are considerably weakened by disease. In case there are several such colonies they should be united before or during treatment, to form strong, vigorous, colonies.

In discussing treatment it is assumed that hives with movable frames are in use. Box-hives are a menace in regions where disease is present. These may be treated for disease by drumming the colony into another box and then hiving it like a swarm in a hive, but box-hives are not profitable and where disease is present are especially to be condemned on account of the difficulty of inspecting and treating them.

SHAKING TREATMENT.

The shaking treatment consists essentially in the removal of all infected material from the colony, and in compelling the colony to take a fresh start by building new combs and gathering fresh stores. This is done by shaking the bees from the old combs into a clean hive on clean frames.

Time of treatment.—The shaking treatment should be given during a flow of honey, so that other bees in the apiary will not be inclined to rob. If this is not possible the operation may be performed under a tent made of mosquito netting. The best time is during the middle of a clear day when a large number of bees are in the field. It is sometimes recommended that shaking be done in the evening, but this is impossible if many colonies are to be treated. The colony can be handled more quickly when the field force is out of the hive.

Preparation.—All implements that will be needed, such as queen and drone trap, hive-tool, and lighted smoker, should be in readiness before the operation is begun. A complete clean hive with frames is provided, as well as a tightly closed hive body in which to put the contaminated combs after shaking. An extra hive cover or some similar apparatus should be provided to serve as a runway for the bees as they enter the new hive. The new frames should contain strips of comb foundation from one-fourth to 1 inch wide. Full sheets are not desirable (when the bees are shaken only once), and if combs built on full sheets of foundation are desired they may be built later.

Operation.—The old hive containing the diseased colony (fig. 4, *A*) is now lifted to one side out of the flight of returning field bees and the clean hive (*B*) set exactly in its place. The cover (*G*) is now taken off and a few frames (*E*) removed from the center of the hive. If unspaced frames are used, those remaining in the hive

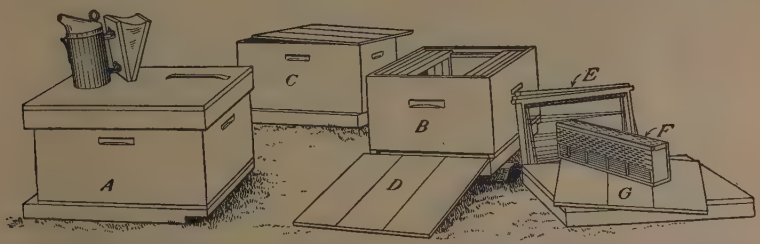


FIG. 4.—Apparatus for the shaking treatment: *A*, Hive containing diseased colony (formerly in position of *B*); *B*, clean hive; *C*, empty hive to receive combs after shaking; *D*, hive cover used as runway; *E*, frames removed from *B* to give room for shaking; *F*, queen and drone trap; *G*, cover for clean hive, *B*.

should be pushed tightly to either side of the hive, thus making a barrier beyond which the bees can not crawl as they move to the top of the hive after shaking. This largely prevents them from getting on the outside of the hive. If self-spacing frames are used, a couple of thin boards laid on the top bars on either side will accomplish the same result. The runway (*D*) is put in place in front of the entrance. The old hive is now opened for the first time. The frames are removed one at a time, lowered part way into the new hive, and with a quick downward shake the bees are dislodged. The frames are then put into the extra hive body (*C*) and immediately covered to prevent robbing. After all the frames are shaken the bees remaining on the sides of the old hive (*A*) are shaken out.

If honey is coming in freely, so that thin honey is shaken out of the combs, cover the runway (*D*) with newspapers and shake the bees in front of the new hive (*B*), leaving all frames in place and the cover on. After the operation the soiled newspapers should be

destroyed. In shaking in front of the entrance the first one or two frames should be so shaken that the bees are thrown against the entrance, where they can locate the hive quickly. They then fan their wings and the others follow them into the hive. If this is not done the bees may wander about and get under the hive or in some other undesirable place.

After the bees are mostly in the new hive a queen and drone trap (*F*) or a strip of perforated zinc is placed over the entrance to prevent the colony from deserting the hive. The queen can not pass through the openings in the perforated zinc and the workers will not leave without her. The queen may also be placed in a queen cage for a couple of days, until the bees have built enough comb for her to use in laying eggs, after which there will be little chance that the bees will desert the hive. In place of the queen and drone trap or the strip of perforated zinc at the entrance, a queen-excluding honey-board may be placed under the hive but above the bottom-board. By the time that new combs are built and new brood is ready to be fed, any contaminated honey carried by the bees into their new hive will have been consumed and the disease will rarely reappear. If it should, a repetition of the treatment will be necessary.

Saving the healthy brood.—The old combs are now quickly removed. If several colonies are being treated at one time it may pay to stack several hive bodies containing contaminated combs over a weak diseased colony to allow most of the healthy brood to emerge, thereby strengthening the weak colony. After 10 or 12 days this colony is treated in turn and all the combs rendered into wax. If only one or two colonies in a large apiary are being treated it will not pay to do this.

Melting the extracting combs.—Since the extracting combs have not contained any of the diseased larvæ, many beekeepers ask whether it is necessary that these be melted up, or whether it is safe to use them over other colonies. In some cases such combs may be used, as in colonies where there is only a little of the diseased material or where no honey has been coming to the hive since the disease was contracted. The saving of such combs, however, is extremely dangerous, and such a policy is not to be advised. The beekeeper who takes all the precautions which it is possible to take is the one who most quickly and cheaply eradicates American foulbrood from his apiary.

Saving the wax.—Any but a very small apiary should have included in its equipment a wax press for removing wax from old combs. If contaminated combs are not to be rendered into wax they should be burned immediately. After the contaminated combs are taken to the honey-house they should be kept carefully covered, so that no bees can reach them until the wax can be rendered. It is not

safe to store such combs in hive bodies except in a securely screened honey-house, and even then they should be well covered. The wax rendering should not be delayed very long or the combs may be ruined by wax moths. The slumgum or refuse remaining after the wax is removed should be burned. Contaminated combs should not be put into a solar wax-extractor for fear of spreading the disease. The wax from contaminated combs may be used safely for the manufacture of comb foundation.

Cleaning the hive.—The hive which has contained the diseased colony should be thoroughly cleaned of all wax and honey, and it is desirable that it be carefully disinfected by burning out the inside with a gasoline blue-flame torch (fig. 5). If this piece of apparatus is not available several hive bodies may be piled together on a hive bottom and some gasoline or kerosene poured on the sides and on some straw or excelsior at the bottom. This is then ignited and after it has been burning for a few seconds a close-fitting hive cover is placed on top of the pile to extinguish the flames. The inside of the hive bodies should be charred to a light brown. The careful cleaning and disinfection of frames always costs considerably more in labor than new frames would cost, but they may be used again if carefully cleaned. Frames may be cleaned by boiling in water for about half an hour, but this frequently causes them to warp badly, and it is a better plan to dip them into boiling lye water which will immediately clean off wax and propolis. The disinfection of hives and frames with chemicals is not recommended, as the ordinary strengths used are valueless for the purpose.

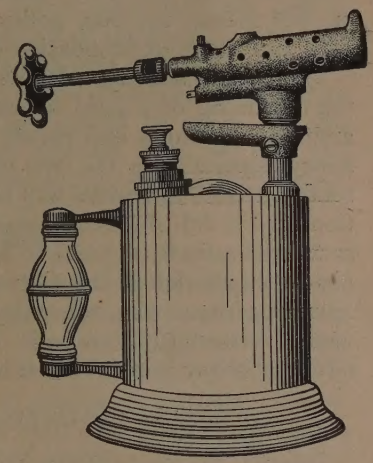


FIG. 5.—Gasoline torch.

Disposal of the honey.—If there is a considerable quantity of honey in the contaminated combs it may be extracted. This honey can not be safely fed to bees without boiling, but it is absolutely safe for human consumption. If there is a comparatively small quantity it may be consumed in the beekeeper's family, care being taken that none of it is ever placed where the bees can get it.

To put such honey on the market is contrary to law in some States. There is always danger that an emptied receptacle will be thrown out where bees can have access to it, thus causing a new outbreak of disease. It can be safely used for feeding to bees, provided it is

diluted with at least an equal volume of water to prevent burning, and boiled in a closed vessel for not less than one-half hour, counting from the time that the diluted honey first boils vigorously. The honey will not be sterilized if it is heated in a vessel set inside of another containing boiling water. Boiled honey can not be sold as honey. It is good only as a food for bees, and even then should never be used for winter stores, as it probably will cause dysentery.

The second shake.—Some beekeepers prefer to shake the bees first onto frames containing strips of foundation as above described, and in four days to shake the colony a second time onto full sheets of foundation, destroying all comb built after the first treatment. This insures better combs than the use of strips of foundation, but is a severe drain on the strength of the colony, and the bees are far more likely to desert the hive. Since it is desirable to have combs built on full sheets, the best policy is to replace any irregular combs with full sheets of foundation or good combs later in the season.

The cost of shaking.—If the treatment just described is given at the beginning of a good honey flow, it is practically equivalent to artificial swarming and results in an actual increase in the surplus honey, especially in the case of comb-honey production. The wax rendered from the combs will sell for enough to pay for the foundation used if full sheets of foundation are employed. Since a colony so treated actually appears to work with greater vigor than a colony not so manipulated, the cost of treatment is small. If treatment must be given at some other time, so that the colony must be fed, the cost is materially increased. In feeding, it is best to use sugar sirup, or honey that is known to have come from healthy colonies.

TREATMENT WITH FULL SHEETS OF FOUNDATION.

In order not to have any combs in the apiary built on strips of foundation, some beekeepers prefer to shake the bees into a hive containing full sheets of foundation. In the place of one of these frames there is put in the hive an old piece of comb—one that has been broken or which for some other reason will not further be useful. Into this comb the bees soon place the honey which they have carried over in their honey-stomachs, and the second morning after treatment the hive is carefully opened, with as little confusion as possible, and this old comb is removed. As little smoke as possible should be used in this operation and the comb should be taken out quickly in order that the bees may not again take up the honey before it is removed. In the place of the old comb there is inserted a new frame containing a full sheet of foundation and the treatment is complete. It will be fatal to success if the old comb is not removed, for then the disease will almost certainly reappear.

TREATMENT WITH BEE-ESCAPE.

As a substitute for the shaking treatment just described, the bees may be removed from their old combs by means of a bee-escape. The old hive is moved to one side and in its place is set a clean hive with clean frames and foundation. The queen is at once transferred to the new hive and the field bees fly there on their return from the field. The infected hive is now placed on top of or close beside the clean hive and a bee-escape placed over the entrance, so that the younger bees and those which later emerge from the cells can leave the contaminated hive but can not return and therefore will join the colony in the new hive. If desired, the infected hive may be placed above the clean hive and a tin tube about 1 inch in diameter placed from the old entrance so that the lower end is just above the open entrance of the new hive. The bees follow down this tube and on their return enter the new hive. When all of the healthy brood has emerged from the infected combs the old hive should be removed. This treatment induces less excitement in the apiary and is preferred by many experienced beekeepers. Care should be taken that the old hive is absolutely tight to prevent robbing. The old hive and its contents of honey and wax are treated as indicated under the shaking treatment.

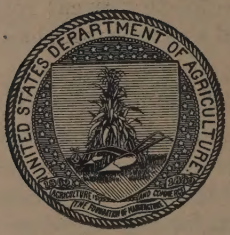
FALL TREATMENT.

If it is necessary to treat a colony so late in the fall that it would be impossible for the bees to prepare for winter, the treatment may be modified by shaking the bees onto combs entirely full of honey so that there is no place for any brood to be reared. This usually will be satisfactory only after brood rearing has entirely ceased. Unless a colony is quite strong it does not pay to treat it in the fall, but it should be destroyed or united to another colony. In case a diseased colony dies outdoors in the winter there is danger that other bees may have opportunity to rob the hive before the beekeepers can close the entrance. If bees are wintered in the cellar it is more advisable to risk wintering before treatment, for if the colony does die the hive will not be robbed.

DRUGS.

Many European writers in the past have advocated the use of various drugs for feeding, in sugar sirup, to diseased colonies, or the fumigation of contaminated combs. In the case of American foulbrood it has been found that the drugs recommended are not of the slightest value and no time should be wasted in their use.

○


UNITED STATES DEPARTMENT OF AGRICULTURE